POLICY IMPLICATIONS AND UTILIZATION OF ICSOPRU RESULTS

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The International Comparative Study on the Organization and Performance of Research Units (ICSOPRU) is conducted under the assumption that it is not only an academically relevant study, but also one from which practical outcomes could be derived. It has always been assumed that ICSOPRU results could provide science policy decision-makers with specific instruments for action. This paper' is a preliminary reflection on this assumption, based on results from Brazil.

1. Brazil's participation in ICSOPRU

Brazil's participation in the ICSOPRU project began with an agreement between UNESCO and the Financiadora de Estudos e Projetos - FINEP - a public funding agency concerned with the development of scientific and technological activities. The execution was entrusted to the Instituto Univesitário de Pesquisas do Rio de Janeiro (IUPERJ) a private, non-profit institute devoted to research and graduate teaching and sociology and political science.

According to the terms of the agreement between FINEP and IUPERJ, Brazil's participation in the ICSOPRU project had as general objectives, "a) to identify a sample of research units within institutions devoted to scientific and technological research, and to interview its members by means of a set of questionnaires; b) to evaluate the importance of organizational, environmental and similar factors that may affect the performance of research

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units in the country" In the long run the project aims were said to be "a) to provide decision-makers involved in the formulation and implementation of national science and technology policies with information concerning the performance of research groups obtained by means of an internationally tested methodology; b) to suggest strategies to improve the administration of scientific research in the country; c) to organize data sets and to develop indices of effectiveness, productivity and organizational climate within research units".

The project started in Brazil in early 1982, and ended in December 1984. The first year was devoted to the adaptation of UNESCO materials to Brazil, development of national addenda identification of a national sample and training of interviewers. The second year was devoted to fieldwork, organization of computerized data sets and writing of preliminary reports. In 1984 part of the original research team continued to work with data analysis, data cleaning and international compatibilization of the Brazilian results. Several papers circulated that year, and a final report in Portuguese is being finished and delivered to FINEP in mid 1985. In January 1985 IUPERJ organized with FINEP an International Seminar on Development, and Scientific and Technological Effectiveness with participation of ICSOPRU and non-ICSOPRU researchers and science policy-makers from Brazil, Argentina Colombia, Mexico, the United States Canada Finland, Sweden. The Netherlands and Ukraine. Presentations of ICSOPRU' s preliminary results were made in several Brazilian governmental and university institutions, including the National Research Council, FINEP and the Catholic and Federal Universities in Rio de Janeiro.

2. Policy-making and social research

Social scientists often declare their studies to be geared to effective utilization in policymaking, while policy-makers support research on the assumption that results could be useful for their purposes. However, effective utilization of research results by policy-makers is rare. Several reasons have been suggested to explain this state of affairs.

A - Social science research is often couched in terms not amenable to the decision-maker's intervention. In fact, decision-makers have only a limited number of variables they are able to manipulate. If a study concludes that variables such as "cultural heritage", or "dependency" are responsible for some undesirable facts, policy-makers can agree, but can usually do nothing about them The reason social scientists deal with this type of variables is

that they are often more interesting from an interpretive point of view; and also because they usually lack theories that utilize less far--reaching variables.

B - Social sciences' statements are usually too imprecise to be amenable to immediate utilization, even if variables are well defined and empirically tested. Quantitative results are typically presented in terms of low correlation coefficients, and there are always problems with assumptions about scalability, universe and sample distribution curves, multicolinearity, and so forth. Quantification does not mean precision.

C - If social scientists are often unable or unwilling to provide decision-makers with readily useable results, decision-makers are often not prone to take social research results into consideration. Priorities may be different, political constraints too strong; or decision-makers may lack the proper' personnel and organization.

D - Social scientists can also provide answers policy makers are not willing to listen, and do not answer what they want to hear. For instance, policy-makers may want to have clear cost--benefit assessments of investments, or decision criteria about alternative uses of public fun'-Js The typical researcher will answer that there are many different dimensions of effectiveness and that long-range scientific research is not amenable to cost-benefit analysis. He will also say that there are no clear--cut, technical criteria to decide, for instance, whether to invest in nuclear or in biological research since it is a matter of political choice He may suggest an improvement of the peer-review system or an enlargement of the agency's constituency. Policy-makers can perceive these suggestions as attempts to limit their authority.

E - Timing is also different. The first negotiations for the ICSOPRU project in Brazil started in 1981 or before, and the main results started to appear in 1984-5. During these years, there were several changes in FINEP's administration, and a profound transformation in the Brazilian government. There is little memory in FINEP today about the original purposes and potential use of ICSOPRU. Lack of continuity due to changes is not just an effect of different people, nor necessarily a consequence of large reformulations of previous concerns and policy orientations. It is mostly a consequence from the lack of well-established administrative organizations and procedures that can carry on with their tasks while changes are made at higher levels. However, large institutional changes are in fact occurring at this moment. The creation of a Ministry of Science and Technology by the Brazilian new government was

supposed to strengthen its commitment with this field; in fact, however, the new Ministry is still being organized, and it is not clear how it will proceed in terms support for science and technology. In contrast, a research project can continue for several years, relatively unhindered by this changes.

Given all these difficulties, one can wonder why the notion that social sciences can provide instruments for active policy making is so commonly sustained. One reason is the sincere concern of social scientists with effective use of their findings, and of policy-makers with improving the quality of their decisions. It also happens that practical justifications can increase the probability of obtaining support for social research, and scientific research can legitimize policy decisions taken on quite different grounds. Either way, there is a clear process of mutual attraction that produces pragmatically oriented research projects, without necessarily leading to applied results

It is clear from the previous discussion that the eventual utilization of results of a given research project depends only partially cm the project's contents. Even the best-applied study would not be utilized by an unstable, unconcerned or incompetent agency; even poorly conceived studies could yield significant information for an active, competent and properly motivated policy institution. The following discussion will be limited to one side of this problem, namely what kind of results from ICSOPRU could be possibly be applied, and how. In other words, I t. will deal with the researcher's side, not with the decision-maker's one

The first two tasks given to the ICSOPRU project in Brazil described the work IUPERJ had to do according to the UNESCO-FINEP agreement. A sample of research units was indeed identified, the UNESCO and national questionnaires were applied, and analyses were made evaluating "the importance of organizational, environmental and similar factors that may affect the performance of research units in the country". Since "performance”, or effectiveness, is the main dependent variable, one should start by discussing it.

3 The measurement of performance

Performance" or research effectiveness appeared to be a multidimensional phenomenon. This means that different research units work for different goats and evaluate themselves and each other, according to different criteria that cannot be reduced to a single

additive index. This fact was observed in all countries where the project was carried on. The main dimensions of effectiveness are:

A - academic effectiveness, expressed in international publications and concern with purely scientific results. In Brazil this is typical of university research units in the fields of biological and exact sciences.

B - applied effectiveness, expressed in national publications and practical/social significance of research. In Brazil, this was most typical of agricultural and medical research

C - technological effectiveness, expressed by the production of experimental devices and patents. It is typical of technological research units in universities and institutes.

D - "internal" effectiveness, expressed by the production of non-published internal reports and compliance with the parent organization's norms and procedures. It is most typical of research units belonging to productive companies

ICSOPRU's indicators for these dimensions have several limitations. Some of these indicators are "objective", in the sense that they refer to numbers of items produced in the different dimensions. This type of information suffers from all criticisms that have been addressed to counting articles, etc., to measure effectiveness. These problems become more acute as one moves from international journals that are supposedly more selective, to national periodicals, where the frontier between truly "scientific" and non-scientific journals becomes fuzzier. To count "experimental devices" and "internal reports" is still more fuzzy in terms of what the answers provided actually contain. There are some ways of improving the quality of these measurements: to work with citations and to weight the journals according to their academic standing, for instance, or to evaluate the worthiness of technological products. These improvements are however impractical for ICSOPRU's scale, and were not attempted.

Other indicators are "subjective", in the sense that they give the units ratings along several items according their own leaders and members In the beginning, attempts were made by ICSOPRU teams check these internal evaluations with ratings done by external judges. However, problems of sampling external evaluator's are almost insurmountable (they may not know enough about the units if selected randomly, or be too biased if nominated by the units themselves). In those countries where external evaluation was performed, it was found that

they did not differ from internal evaluations, and were usually less severe. Because of this, the decision was made not to proceed with the external evaluations.

In order to test for the quality of these indicator's in Brazil, the units were distributed according to whether they ranked high or low in several dimensions of effectiveness, and these results were compared, for units in universities, with ratings their institutions (departments or programs) received from CAPES, an agency from the Ministry of Education which provides support for graduate studies. The results can be seen in table 1.

Table 1 - Average rating by CAPES(*) for Research Units in universitie, by different effectiveness dimensions (N=150)

	efectiveness		probability(**)
	high	low	
articles published in the country	1.73	1.95	0.28
articles published abroad	1.60	2.04	0.02
experimental devices	1.50	2.15	0.00
training effectiveness	1.90	1.77	0.27
national reputation	1.82	1.92	0.60
social relevance	2.02	1.81	0.31
follow up	2.03	1.78	0.23

(*) CAPES ratings are given to graduate programs by peer review committees which receive full documentation about the programs' activities, publications, dissertations produced, etc. They vary from A (1) to D or E (4). For this test, we attributed to the units the ratings received by the programs to which they are associated.

(**) Provided by analisys of variance, it expresses the chances that between-group differences are not different from within-group differences.

What this table shows is that CAPES's ratings fit well with two indicators of effectiveness, production of experimental devices and articles in international journals. They fit also, although more weakly, with production of articles in national journals. This means that, in spite of their limitations, these indicators can be taken as reasonable references to the unit's performance. For the remaining indicators (except reputation), however, the relationships are non-existent or negative, that is, the groups that rate themselves higher get lower CAPES marks! There are two alternative ways of interpreting these results. The first is that self-ratings are self-serving, and cannot be taken as measures of effectiveness. The second is that CAPES' evaluations are biased towards measurable products and do not account for more qualitative realities captured by ICSOPRU questionnaires. In any case, this test casts a shadow of doubt on the true meaning of self--rated effectiveness indicators.

We can conclude that ICSOPRU data measure reasonably well in aggregate terms, what science indicators usually grasp, that is, academic performance. The quality of these indicators becomes fuzzier as we move to other dimensions, and it is practically impossible to say what

"internal effectiveness" means although we can suspect that, in this case it may have little to do with objectively effective science and technology.

4 Environmental and other factors affecting performance.

Two environmental factors have a clear impact on effectiveness of research units, namely the type of institution and the geographic region where they are located. These two variables, plus the different fields of knowledge were utilized as predictors. In an analysis having as dependent variables the production of articles in the national and international literature (the analysis was performed using the program "Search" from the OSIRIS IV statistical system; results are presented in tables 2 and 3 in tree form).

Table 2: Influence of field of knowledge, institution and regional location on the production of articles in national publications.
(total of explained variance, 14.3%)

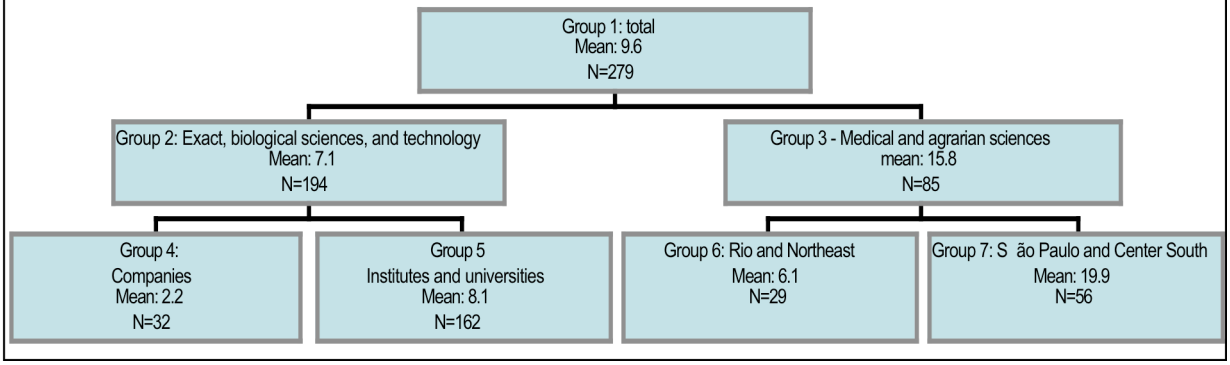
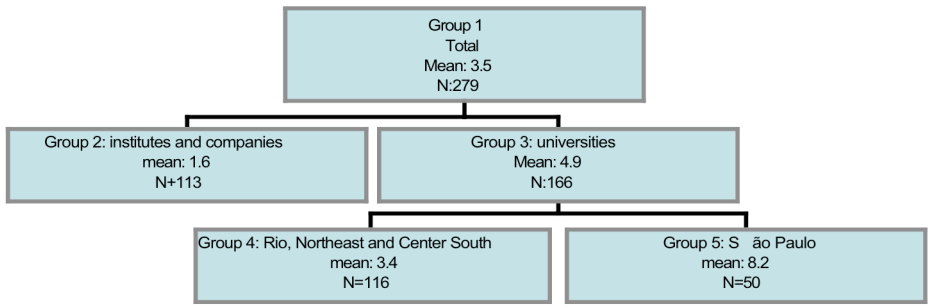


Table 3: influence of field of knowledge, institutions and regional locatgion on publication of articles in the international literature
(explained variance: 11%)



Institutional factors seem to have mostly a negative impact on production of published materials. Units in companies produce least, while units in universities may produce more. International publications are limited to university research units. High productivity is not explained by institutional factors, but by "geography": a condition for high publication is to be located in Sao Paulo or at least, for articles in national journals, in the Center-South region of the country. Field of knowledge influences mostly what kind of product one has national publications for agriculture and medicine, international publications for biology and physics, few publications for technology. What is behind "geography" is, of course, economic and social development.

Policy implications of this finding are many. In spite of all difficulties, universities seem to be best location for research work, either of applied or of more academic orientation. The advantages of university research are first, that they can provide a good environment for "entrepreneurial" activities of unit leaders, which are more restricted in their initiatives in non university institutions; second, they have the presence of graduate students; third, the reward system for university research can be more closely adjusted to scientific achievements than the reward systems in non university environments. This means that the tendency of the Brazilian government in the last several years to invest heavily in non-university research might have been misdirected. However, to be in a university environment is not enough: it has to be a "good" university, with characteristics that are usually found only in the more developed regions in the country. It is interesting, in this regard, to notice that this is not a simple matter of economic resources, since Rio de Janeiro appears in this analysis closer to the Brazilian Northeast than, for instance, Minas Gerais. What are the characteristics of "good" institutions?

4. Organizational and administrative factors

Administrative factors seem to play a relatively unimportant role in the performance of research units. Tables 4 to 6 summarize the main findings. Factor analyses were performed for questions J, K and Q of the ICSOPRU core questionnaires. Question J deals with leadership patterns of involvement, question K with working climate and question O with organization and planning of research work Then, factor scores were produced and an analysis of variance was utilized to calculate aver-age scores for units high and low in different effectiveness measures (the same as in table one) The tables gives only the values found for the highly effective groups in each dimensions, and asterisks indicate if their differences with low performing groups are significant.

Factor analysis indicates that leaders get involved in the unit's work along three dimensions: project's conception and design, research work and research administration. Of the three, only involvement in project's conception and design relates with effectiveness in its many dimensions The more significant relations, however', are with subjective effectiveness, not with quantitative measures. Leader's involvement with actual research work bear no relationship with effectiveness, and involvement with research administration seems to have only minor impact. Patents production appears very rarely in the Brazilian study, and seems to be the product of odd, individual initiatives this may explain the negative relation it has with the leader's involvement with the first factor (table 4).

Table 4: involvement of leaders with different dimensions of research

	leader's participation in		
	project's conception and design	research work	research administration
Dimensions of effectiveness:			
articles published in the country			
articles published abroad	.30*		
experimental devices			
patents produced	-.53**		
training effectiveness	.44**		.21*
Innovativeness	.55**		
national reputation	.38**		
General contribution to C&T	.56**		.30*
social relevance	.44**		
follow up			

Factor scores are standardized. The table shows only values where there are
*: p<.10
** P <.01

The units' working climate includes four dimensions: a general pattern of more or less conflicts; the existence of technical cooperation among members external (administrative, environmental) difficulties; and levels of internal participation (meetings, information sharing) Here again, only the second factor has systematic relations with effectiveness; but there are no relations with indicators of academic performance, while the relation with technological effectiveness (experimental devices) is negative In short, units where people are united by technical cooperation and a feeling of innovation perceive themselves as effective, which does not mean they are actually so More psychological and environmental conditions (feeling of participation, conflicts, external difficulties) seem to he irrelevant (table 5).

Table 5: Working climate (question K) in highly performing units (N=201)

	working climate			
	conflictiveness	technical cooperation	external difficulties	participation
Dimensions of effectiveness:				
articles published in the country				
articles published abroad				
experimental devices		-.30*		
patents produced				.45*
training effectiveness		.58**		
Innovativeness		.51**		
national reputation		.42**	-.33*	
General contribution to C&T		.40*		.30*
social relevance		.60**		
follow up	-.28*	.69**		

Factor scores are standardized. The table shows only values where there are significant differences between high and low performing units.
*: p<.10
** P <.01

Table 6 follows the same pattern. Four dimensions of organization and planning of research work were identified: quality of research work, quality of follow up and applications, high participation and unified budget. The most important is quality of research work, secondly the quality of applications and follow up (the relative importance of each factor is given by the percentage of total variance of items explained by its factor loadings). High participation tends to have mixed, but predominantly negative impact on effectiveness the same happening with unification of the units' budget an independent factor of minor (and negative) weight.

Table 6. Organization and planning characteristics of highly performing units (N=238)

	charcteristics			
	good research work	good follow-up, appications	high participation	unified budget
Dimensions of effectiveness:				
articles published in the country			-.27*	
articles published abroad	.32*	.35*		
experimental devices			-.27*	-.26*
patents produced			-.35*	
training effectiveness	.72**			
Innovativeness	.65**	.42**		
national reputation	.67**			-.16*
General contribution to C&T	.50**	.47**		
social relevance	.37**	.69**	.33*	-.29*
follow up	.31*	.51*	.26*	

Factor scores are standardized. The table shows only values where there are significant differences between high and low performing units.

*: p<.10

** P <.01

In short, the analysis suggests strongly that effectiveness as a subjective feeling is related with perception of quality of the unit's scientific and technological work, and its leaders' involvement with research design and conception; that purely administrative or socio-psychological conditions are irrelevant; but most fundamentally, that actual effectiveness tends to have little relationship with all these variables The policy implication of this finding is clear: there is no point in investing money and effort in the improvement of administrative conditions or on the so-called "organizational development" of research units; they either have scientific competence - and it that case they would usually obtain the administrative resources they need - or they are hopeless.

5. Individual characteristics

One of ICSOPRU's basic assumptions is that scientific and technological research is a group not individual process. This is certainly an improvement over conventional empirical sociology, which tends to work with individuals as its main unit of analysis. Sociology of science and common knowledge, however, usually emphasizes the role of individuals in scientific and technological production as leaders, innovators, and researchers.

A test of the individual vs. group hypotheses can be done through table 7. Regression analyses were made with 1,112 scientists and engineers interviewed in the project. They show that articles in the international literature are, among all items, the ones more strongly related

to individual achievement. They have the highest correlation with doctoral degrees; show little or no influence from the institution where the scientist works, from his role (whether he is a leader or not), or from his field of knowledge.

Table 7: determinants of individual productivity (multiple regression analysis)

	Products			
	articles in international journals	internal routine reports	patents or patents requested	
position as unit leader	0.138	0.088	0.127	0.061
male	-0.013	-0.011	-0.090	-0.024
fully dedicated to research in the unit	-0.107	0.006	-0.052	-0.024
fully dedicated to teaching and research	-0.002	-0.002	-0.019	0.008
does research within and outside the unit	-0.020	0.007	0.012	0.081
has a doctoral degree	0.158	0.290	-0.061	-0.041
unit belongs to a university	-0.064	0.045	-0.173	-0.115
unit belongs to a company	-0.134	-0.061	-0.360	-0.043
technology	-0.014	-0.063	-0.036	0.039
exact and earth sciences	0.450	0.003	-0.078	0.022
medical research	0.117	-0.011	-0.031	0.058
agricultural research	0.179	-0.035	-0.005	-0.039
has studied abroad	0.010	0.116	0.013	0.048
present work related to the field of eduction	0.087	0.090	-0.005	0.016
São Paulo	0.033	0.079	0.006	0.024
Rio de Janeiro	0.078	0.078	0.007	0.037
Northeast	0.002	0.000	-0.005	0.015
(1) y=log(1+x)				
*** p <.001				
** p < 010				
* p <.100				

Articles in national journals and in Portuguese, however, follow a very different pattern. They also depend on a doctoral degree, but to a lesser extent. They tend to increase if the researcher is a unit leader, works in a research institute in the fields of medical and agricultural sciences, and is not dedicated full--time to research work in his unit. These articles are probably less academic in nature, and the journals that publish them are likely not to be strictly scientific or technical.

Internal routine reports, at the other extreme, are strongly dependent on institutional variables. To produce them, one has to be a scientific leader, female (it is impossible to explore further the meaning of this finding here), to work in a company, not in a university, not to have a doctoral degree, and not work in the exact or earth sciences.

Technical products have patterns of their own. Patents, which are extremely rare, occur outside the universities, and are made by people who have studied abroad and work both within and outside their main institutions. There is also some concentration of patents in the medical (presumably, pharmaceutical) area. The impression is that the few patents that exist are odd events that depend on the work of a few independent, free-lance individuals. Experimental

devices, however, have clearer determinants. Mostly, they depend on whether one works in the fields of technology and exact sciences, which usually means, in Brazil, that one is male. They also require a shift from some previous specialization into a new one. Given these conditions, this type of product seems to come naturally.

In short, some scientific products depend on personal achievement along the academic path, others on one's institutional and disciplinary insertions; others, like patents, do not seem to have found a definite place or a source for incentive. These products are not interchangeable: those with a clear scientific and technological content are more clearly related with individual characteristics than those expressing routine or bureaucratic work Policy implications of these findings are self--evident, and in line with previous conclusions: the locus for scientific and technological achievement seems to he essentially the individual. If competent researchers are obtained, and if they can be provided with space to develop and adequate support good research is likely to be forthcoming. Then it will be important to ask about the role of organizational institutional and environmental supporting conditions. If not, all this is quite irrelevant. This conclusion seems to be trivial for anyone who is a professional researcher. However, it is not so self-evident for those in charge of science policy and policy administration in so many countries striving to build up their scientific potential.

6. ICSOPRU and administrative support: information, strategies and indices

The ICSOPRU project in Brazil can, therefore, point to some basic strategies to be followed by policy-makers, and to some dead ends in previous conceptions on how to go about this task. The ambition, however, was higher: the project was meant, as stated in the beginning, to provide decision-makers with specific tools for their day-to-day activities.

The first of these tools were to be "information concerning the performance of research groups obtained by means of an internationally tested methodology." This tool cannot be provided for two reasons. First, the ICSOPRU project is based on clauses of confidentiality, and no information on specific units could be provided to policy-making authorities. Secondly, as we have seen, the measurements utilized in the project are useful only for cross-section analyses. They are useful to make broad comparisons and to test general hypothesis, but are not discriminating enough to provide precise evaluations of specific units. In fact, the ICSOPRU study in Brazil spotted a few areas that seem to be particularly problematic. For instance, units

of medical research in general and agricultural research in the universities show several indications of trouble, and units in large, state-owned companies are probably quite ineffective in comparison with their costs It is difficult, however, to go much beyond these general statements, and ICSOPRU is not a good instrument for continued monitoring of performance.

The international validity of ICSOPRU's indices is also open to questions. It is still not clear, at least for this author, how useful is the international component of the project. Most of the analyses done so far with ICSOPRU data have been national; when comparisons are made, they have seldom gone beyond merely descriptive tables. Sometimes units of different countries are lumped together, but the "country variable" is seldom taken into consideration. A lot of effort has been placed in assuring item-per-item comparability among national studies. However, there are some basic uncertainties on how the definition of "research unit" was adopted in different countries, and on how the institutional variable was considered. The meaning of products such as "articles in national literature", "books published" and "patents" vary widely among countries. They depend on the historical linkage a country has with international research centers, the existence or not of local journals, the local concept of "book", the state of national book industry, the national patent legislation, and so forth. As the ICSOPRU project migrates from Western Europe to Eastern Europe, Latin America, Asia and Africa, difficulties with assuring item-by-item comparability will tend to increase, and its worthiness are bound to become more problematic. There is an obvious problem of diminishing returns in this process, which should be taken into account.

The second tool would be "to suggest strategies to improve the administration of scientific research". Some strategic considerations have already been mentioned. They refer to policy contents, since there is nothing in the project that deals directly with the way policy-makers should organize them for implementing these or other strategies. However, if the conclusions about the importance of individual and leadership factors is warranted, a point could be made for the need for science policy agencies to rely as much as possible on peer review mechanisms instead of on purely organizational or administrative procedures of evaluation and research support, since peers are obviously better at identifying quality than civil servants.

Finally, there is the suggestion that ICSOPRU could provide decision-makers with "data sets and indices of effectiveness, productivity and organizational climate within research

units". This can also be interpreted in terms of a system of permanent monitoring. Even if the confidentiality clause were raised for, future ICSOPRU-like studies, one could still wonder whether this kind of semi-permanent evaluation would not be too costly and a source of unnecessary nuisance and friction between scientists and policy-makers. General receptivity for the ICSOPRU project was good in Brazil, but it would probably deteriorate if it were to he repeated every two or three years More fundamentally, it is clear that monitoring of scientific performance can only be done through active participation of the scientific community, and requires specific evaluations of contents of the results obtained, something which is beyond the scope of cross-section studies such as this.

7 Conclusion

ICSOPRU is certainly a good instrument to provide an overview of the way scientific work is organized in different settings and countries. It requires fairly sophisticated analytical skills, and its potential for international generalizations lies probably more on comparisons of findings than on item-by-item tabulations. In spite of its original emphasis on group theory, it contains important individual-based information that should not be neglected. If properly analyzed, this project provides non-trivial insights. However, it is not adequate for furnishing decision-makers with ready--made information on a unit-by-unit basis or precise decision criteria on specific circumstances. It says nothing about how science policy agencies should get organized to fulfill their tasks.

How decision-makers will use these results depend on their ability to understand the project's conclusions and their freedom to act. Given the general difficulties in the relations between policy-making and social research, it is probably an error to try to direct the analytical effort in a project such as this only to the decision-makers' benefit. If the research is well done and, more important, properly analyzed, results will appear', and help to form opinion. Then, if policy does not follow from accepted knowledge, it is for reasons that usually lie well beyond what researchers can do.